

## CLAIMS

We claim:

1. An automated storage and retrieval apparatus for storing containers at ultra low temperatures, said apparatus comprising:

a freezer compartment, said freezer compartment having a side wall;  
a storage carousel disposed inside said freezer compartment for holding the  
5 containers;

a climate-controlled chamber disposed on said side wall;  
a climate system for controlling the climate of said chamber;

an interchange mechanism configured to:

interchange a container between said interchange mechanism and said  
10 climate-controlled chamber while in a chamber exchange position,  
and

interchange a container between said interchange mechanism and said  
carousel while in a carousel exchange position; and

said chamber being configured to:

15 isolate the container from said interchange mechanism as container is  
deposited from the exterior or placed into the exterior, and  
isolate the container from the exterior as container is exchanged between  
said chamber and said interchange mechanism.

2. The apparatus of claim 1, wherein said chamber further comprises:

an exterior door, whereby said exterior door is adapted to allow the containers to  
interchange between said chamber and the exterior, and

an interior door, whereby said interior door is adapted to allow the containers to  
5 interchange between said chamber and said interchange mechanism.

3. The apparatus of claim 1, where said chamber further comprises:

a transport tray slidably mounted to said chamber for transporting the container  
between an outer position closest to the exterior and an interior position closest to said  
interchange mechanism.

4. The apparatus of claim 3, wherein said controlled chamber further comprises:

a motor operably connected to said transport tray for translating said tray between the exterior position and interior position, and any position generally there between; and  
5 said motor being disposed outside said freezer compartment.

5. The apparatus of claim 1, wherein said climate system comprises a dry gas supply to dehumidify said chamber and cool said chamber.

6. The apparatus of claim 1, wherein said chamber comprises a writing device.

7. The apparatus of claim 1, wherein said chamber comprises a reading device to identify the containers as they are inserted into and retrieved from said chamber.

8. The apparatus of claim 1, further comprising a control system, wherein said control system is operatively connected with said carousel, said interchange mechanism, and chamber for controlling their operations.

9. The apparatus of claim 8, wherein said control system comprises a processor for processing data relative to the containers being stored in and retrieved from the apparatus.

10. The apparatus of claim 8, wherein said control system comprises a processor for processing data relating to contents of the containers being stored in and retrieved from the apparatus.

11. The apparatus of claim 8, further comprising a user station operatively connected to the apparatus, said user station comprising a data input means for inputting data to said processor relative to the containers.

12. The apparatus of claim 1, wherein said interchange mechanism comprises:  
a picking mechanism translating said interchange tray for interchanging the  
container with said carousel or said chamber.

13. The apparatus of claim 12, wherein said interchange mechanism further  
comprises:  
an interchange tray configured to retain the container.

14. The apparatus of claim 12, wherein said interchange mechanism further  
comprises:  
a vertical transporter configured to allow said interchange mechanism to be  
translated vertically over a plurality of discrete heights.

15. The apparatus of claim 14, wherein said interchange mechanism further  
comprises:  
a rotary transporter, said rotary transporter configured to rotate said interchange  
mechanism to a plurality of discrete circumferential positions.

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16. The apparatus of claim 15, wherein said circumferential positions include  
rotational alignment corresponding to a position at which the interchange mechanism can:  
interchange selected containers with said climate-controlled chamber  
while in the chamber exchange position; and  
5 interchange selected containers with said carousel while in the carousel  
exchange position.

17. The apparatus of claim 15, further comprises:  
a motor operably connected to said rotary transporter for rotating said interchange  
mechanism the plurality of discrete circumferential orientations; and  
said motor being disposed outside said freezer compartment.

18. The apparatus of claim 14, wherein said discrete heights include the heights corresponding to a height at which the interchange mechanism can:

interchange selected containers with said climate-controlled chamber while in the chamber exchange position; and

5 interchange selected containers with said carousel while in the carousel exchange position.

19. The apparatus of claim 14, further comprises:

a motor operably connected to said vertical transporter for vertically translating said interchange mechanism to discrete heights; and

said motor being disposed outside said freezer compartment.

20. The apparatus of claim 12, further comprises:

a motor operably connected to said picking mechanism for substantially horizontally translating said picking mechanism between an extended position for use during the interchanging of the container, and a retracted position while the container  
5 remains in the non-extended position; and

said motor being disposed outside said freezer compartment.

21. The apparatus of claim 1, wherein said carousel further comprises an annular ring of vertical racks arranged circumferentially.

22. The apparatus of claim 21, wherein said carousel further comprises storage trays to hold a plurality of storage containers.

23. The apparatus of claim 22, wherein said storage trays are adjustably mounted.

24. The apparatus of claim 21, wherein said carousel further comprises an upper horizontal top plate and a lower horizontal support plate.

25. The apparatus of claim 21, wherein said carousel is rotatable so as to align said vertical racks with said interchange mechanism.

26. The apparatus of claim 21, further comprising:  
a motor operably connected to said carousel for rotating said carousel; and  
said motor being disposed outside said freezer compartment.

27. An automated storage and retrieval apparatus for storing containers at ultra low temperatures, said apparatus comprising:

- a freezer means for freezing the containers;
- a storage means disposed inside said freezer means for holding the containers;
- 5 a chamber means for interchanging the containers between the exterior and said freezer means;
- a climate system control means for controlling the climate of said chamber means;
- an interchange means for:
  - interchanging a container between said interchange means and said
  - 10 chamber means while in a chamber exchange position, and
  - interchanging a container between said interchange means and said storage means while in a storage exchange position; and
- said chamber means for:
  - isolating the container from said interchange means as container is
  - 15 deposited from the exterior or placed into the exterior, and
  - isolating the container from the exterior as container is exchanged between said chamber means and said interchange means.

28. An automated storage and retrieval apparatus for storing containers at ultra low temperatures, said apparatus comprising:

- a freezer compartment, said freezer compartment having a side wall;
- 5 a storage device disposed inside said freezer compartment for holding the containers;
- a climate-controlled chamber disposed on said side wall;
- a climate system for controlling the climate of said chamber;

an interchange mechanism configured to:

- 10 interchange a container between said interchange mechanism and said  
climate-controlled chamber while in a chamber exchange position,  
and  
interchange a container between said interchange mechanism and said  
storage device while in a device exchange position; and  
15 said chamber being configured to:  
isolate the container from said interchange mechanism as container is  
deposited from the exterior or placed into the exterior, and  
isolate the container from the exterior as container is exchanged between  
said chamber and said interchange mechanism.

29. The apparatus of claim 28, wherein said storage device is movable so as to align said storage device with said interchange mechanism.

30. The apparatus of claim 28, wherein said storage device is stationary.

31. A method for automatically depositing and storing containers in a freezer compartment at ultra low temperatures, said method comprising:  
providing a carousel in said freezer compartment;  
depositing a container into a climate-controlled chamber;  
5 controlling the climate of said chamber while isolating said chamber for a  
predetermined time while the container remains in said chamber;  
retrieving the container from said chamber to said freezer compartment while said  
chamber is isolated from the exterior; and  
storing the container in said carousel.

32. A method for automatically storing and retrieving containers in a freezer compartment at ultra low temperatures, said method comprising:  
providing a carousel in said freezer compartment;  
providing a climate controlled chamber;

5            retrieving a stored container from said freezer into said climate controlled  
             chamber, while said chamber is isolated from the exterior;  
             controlling the climate of said chamber while isolating said chamber for a  
             predetermined time while the container remains in said chamber; and  
             presenting the container for pickup while said chamber is isolated from said  
10           freezer compartment.

33.        The method of 32, wherein said presenting the container comprises  
             ejecting the container to the exterior for pickup.

34.        A method for automatically depositing and storing containers in a freezer  
             compartment of an automated apparatus at ultra low temperatures, said apparatus  
             comprising:

             a freezer compartment, said freezer compartment having a side wall;  
5           a storage carousel disposed inside said freezer compartment for holding the  
             containers;  
             a climate-controlled chamber disposed on said side wall;  
             a climate control system for controlling the climate of said chamber;  
             an interchange mechanism configured to:  
10           interchange a container between said interchange mechanism and said  
             climate-controlled chamber while in a chamber exchange position,  
             and  
             interchange a container between said interchange mechanism and said  
             carousel while in a carousel exchange position; and  
15           said chamber being configured to:  
             isolate the container from said interchange mechanism as container is  
             deposited from the exterior or placed into the exterior, and  
             isolate the container from the exterior as container is exchanged between  
             said chamber and said interchange mechanism.

35. A method for automatically storing and retrieving containers in a freezer compartment of an automated apparatus at ultra low temperatures, said apparatus comprising:

- a freezer compartment, said freezer compartment having a side wall;
- 5 a storage carousel disposed inside said freezer compartment for holding the containers;
- a climate-controlled chamber disposed on said side wall;
- a climate control system for controlling the climate of said chamber;
- an interchange mechanism configured to:
- 10 interchange a container between said interchange mechanism and said climate-controlled chamber while in a chamber exchange position, and
- interchange a container between said interchange mechanism and said carousel while in a carousel exchange position; and
- 15 said chamber being configured to:
- isolate the container from said interchange mechanism as container is deposited from the exterior or placed into the exterior, and
- isolate the container from the exterior as container is exchanged between said chamber and said interchange mechanism.

36. A method for automatically depositing and storing containers in a freezer compartment of an automated apparatus at ultra low temperatures, said apparatus comprising:

- a freezer means for freezing the containers;
- 5 a storage means disposed inside said freezer means for holding the containers;
- a chamber means for interchanging the containers between the exterior and said freezer means;
- a climate system control means for controlling the climate of said chamber means;
- an interchange means for:
- 10 interchanging a container between said interchange means and said chamber means while in a chamber exchange position, and



interchanging a container between said interchange means and said storage means while in a storage exchange position; and  
 said chamber means for:

- 15 isolating the container from said interchange means as container is deposited from the exterior or placed into the exterior, and  
 isolating the container from the exterior as container is exchanged between said chamber means and said interchange means.

37. A method for automatically storing and retrieving containers in a freezer compartment of an automated apparatus at ultra low temperatures, said apparatus comprising:

- a freezer means for freezing the containers;  
 5 a storage means disposed inside said freezer means for holding the containers;  
 a chamber means for interchanging the containers between the exterior and said freezer means;  
 a climate system control means for controlling the climate of said chamber means;  
 an interchange means for:  
 10 interchanging a container between said interchange means and said chamber means while in a chamber exchange position, and  
 interchanging a container between said interchange means and said storage means while in a storage exchange position; and  
 said chamber means for:  
 15 isolating the container from said interchange means as container is deposited from the exterior or placed into the exterior, and  
 isolating the container from the exterior as container is exchanged between said chamber means and said interchange means.